



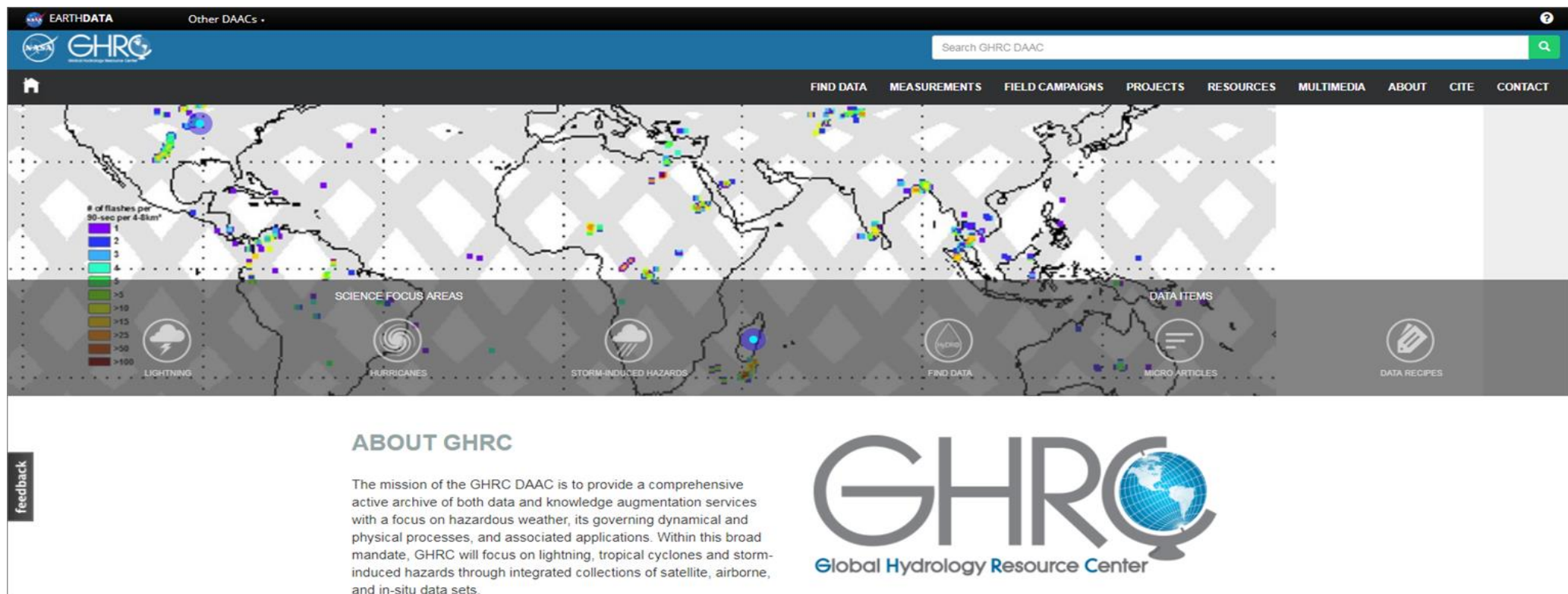
Lightning Web Updates, Data Metrics, and Outreach

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2017 GHRC User Working Group Meeting
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- LIS data first available through GHRC website in August 2017
- Outreach team has spent time this year focusing on improving lightning information available to users and getting lightning data noticed



- We assisted NASA with activities, helping them to focus on lightning also

- User Profile
- LIS article

User Profile: Dr. Rachel Albrecht

Who uses NASA Earth science data? Dr. Rachel Albrecht, to pinpoint global lightning hotspots.



Dr. Rachel Albrecht climbing to the observation level of the Amazonian Tall Tower Observatory (ATTO), located

Dr. Rachel Albrecht, Professor, Department of Atmospheric Sciences, University of São Paulo, Brazil

Research interests: Cloud electrification, lightning nowcasting of severe weather, cloud-aerosol-particle interactions (CAPI), and local circulation effects in convection.

Research highlights: If you live an 80-year life, the chance of being struck by lightning are 1 in 13,500, according to the National Weather Service (NWS), with a 1 in 1,083,000 chance of being struck in a given year. Lightning seems to play favorites, both for people and locations.

Roy Sullivan, for example, had what could be described as an attractive personality. Sullivan (1912-1983), a park ranger in Shenandoah National Park in Virginia, was reportedly struck by lightning seven times between 1942 and 1977. Aside from his hair catching on fire

New Lightning Imaging Sensor to be Installed on the International Space Station



The installation of a Lightning Imaging Sensor (LIS) on the International Space Station (ISS) will enable detection of 98% of Earth's lightning on an annual basis.

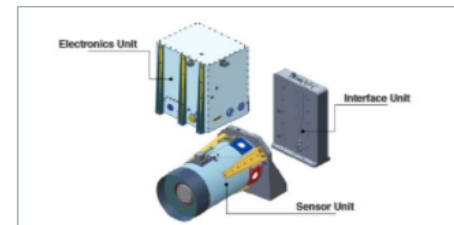
Josh Blumenfeld, EOSDIS Science Writer

When the joint NASA/Japan Aerospace Exploration Agency Tropical Rainfall Measuring Mission (TRMM) satellite re-entered Earth's atmosphere in 2015, it left an invaluable 17-year record of Earth observation data collected by TRMM's five instruments. One of these instruments was the Lightning Imaging Sensor (LIS), which collected data on day and night cloud-to-ground/water, cloud-to-cloud, and intra-cloud lightning and its distribution around the globe.

Now, a new LIS is headed to the International Space Station (ISS) that will continue and enhance this data record. The instrument is part of the Space Test Program-Houston 5 (STP-H5) mission, which is aboard the upcoming ISS cargo resupply mission (designated CRS-10). CRS-10 is scheduled for launch in mid-February 2017.

In all fairness, the LIS headed to the ISS is not really "new." It actually is the spare LIS that was built at the same time as TRMM's LIS and is identical to the TRMM instrument. After attachment to the ISS' EXPRESS Logistics Carrier-1, LIS is expected to collect lightning data for two to four years or longer. These data and data products will be available through NASA's Global Hydrology Resource Center (GHRC) Distributed Active Archive Center (DAAC), which also is the home for TRMM LIS data.

LIS on ISS builds on the observations from LIS on TRMM as well as lightning data collected by the earlier Optical Transient Detector (OTD), which was operational from



The LIS instrument comprises the sensor and an electronics unit. LIS is designed to detect and pinpoint

- We developed Micro Articles and Data Recipes around Lightning
 - [LIS Very High Resolution Lightning Climatology and ArcGIS](#)
 - [Lightning Phenomenon Micro Article](#)
 - [Peterson's Publication Micro Article](#)
 - [Albrecht's Publication Micro Article](#)
 - [OTD Instrument Micro Article](#)

Earth Observations: Optical Transient Detector (OTD)

INSTRUMENT
Passive Remote Sensing | Photon/Optical Detectors | Optical Transient Detector (OTD)

INSTRUMENT PLATFORM
Earth Observation Satellite

Description
The Optical Transient Detector (OTD), a space-based lightning imager on the Orbview-1 satellite, operated during April 1995 to March 2000 as a Lightning Imaging Sensor (LIS) prototype. OTD detected total lightning (cloud-to-cloud, cloud-to-ground, and intracloud flashes) between +/- 75 degrees latitude, but could not distinguish between lightning types.
The OTD was essentially a wide field-of-view telescope that captured 500 Earth surface snapshots per second. The supporting electronics monitored these videos for the rapid pulses of light produced by lightning. The pulses were used to detect lightning at any time of day and determine the optical properties such as lightning location, radiant energy, and number of illuminated pixels.
Detection efficiency varied between 0.37 (noon) and 0.52 (~5pm), changing with sensor threshold settings, time, location, and storm structure. Detection efficiency was much less in the South Atlantic Anomaly where high-radiation levels interfered with instrument measurement. If a storm had optically thick clouds, reflection off middle cloud layers, or low flash altitudes, the lightning signal was difficult to detect.

Measurements
Data obtained include amount, rate, and radiant energy of total lightning during both day and night, lightning distribution, and variability of total lightning.

Applications
Severe Weather | Convective | Latent Heat | Thunderstorms | Water & Energy | Climate

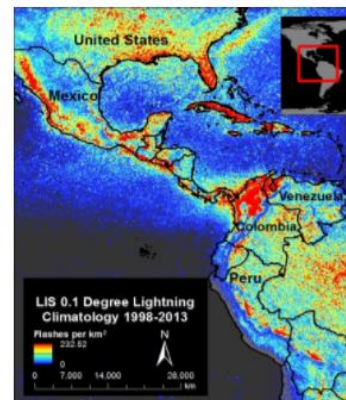
Using ArcGIS to Convert LIS Very High Resolution Gridded Lightning Climatology NetCDF Data to GeoTIFF Format

[Description](#) | [How to Use](#) | [Dataset Information](#) | [Key Parameters](#)

Description

The Lightning Imaging Sensor (LIS) aboard the Tropical Rainfall Measuring Mission (TRMM) satellite collected over 17 years of optical lightning observations that were used to generate a Very High Resolution Lightning Climatology dataset available in gridded netCDF format. ArcGIS software does not handle all netCDF data equally due to how the geographic and other information are formatted within datafiles, thus it is best suited for gridded netCDF files. This data recipe provides a step-by-step tutorial on how to bring these gridded netCDF data into ArcMap and create a GeoTIFF file enabling GIS analysis and map making. This data recipe requires a pre-installed version of ArcMap and a downloaded file from the LIS 0.1 Degree Very High Resolution Lightning Climatology Collection available at GHRC.

Image created using LIS 0.1 Degree Very High Resolution Gridded Lightning Full Climatology (VHRFC) dataset in ArcMap 10.2



LIGHTNING



Atmospheric Phenomenon

WHAT IS LIGHTNING?

Lightning is the electrical discharge between positively and negatively charged regions within clouds. The electrical discharge serves as an equalization process between the charged regions, and can travel from cloud-to-cloud, cloud-to-ground, or cloud-to-air. Visually, lightning is comprised of bright flashes of light called strokes. The loud sound of thunder that accompanies lightning is a sonic shock wave produced by the rapid expansion of the air surrounding the lightning channel during the stroke, similar to a sonic boom. Lightning and thunder occur at the same time, however, because light travels faster than the speed of sound, lightning may be observed sooner than thunder is heard.



Image Source: Wikimedia Commons

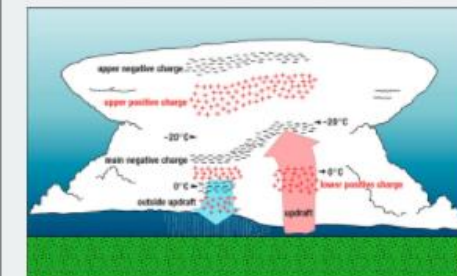


Image Source: NOAA NSSL

Why does lightning occur?

Growing ice particles within a cloud interact with each other through collision, causing the particles to fracture and break apart. It is currently believed that smaller ice particles tend to acquire a positive charge, while the larger particles acquire a more negative charge. Under the influences of thunderstorm updrafts and gravity, these particles separate until the upper portion of the cloud acquires a net positive charge, and the lower portion of the cloud becomes negatively charged. This separation of charge produces electrical potential both within the cloud and between the cloud and ground. Eventually, the electrical resistance in the air between the charged regions breaks down and a flash begins. The resulting lightning strokes are an electrical discharge between the positive and negative regions of a thunderstorm.

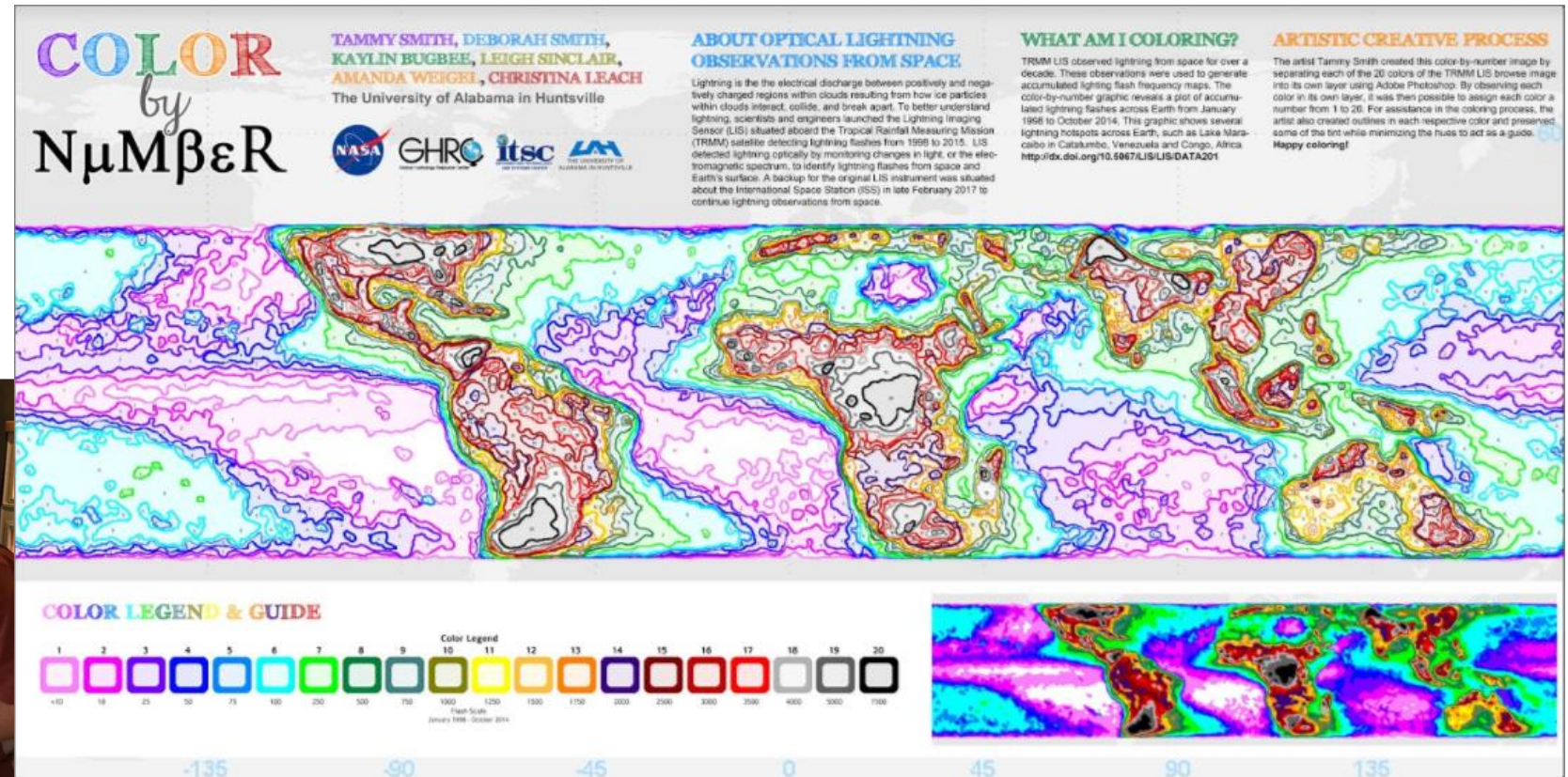
Where does lightning occur?

Lightning occurs in many places around the world. Over the land, much



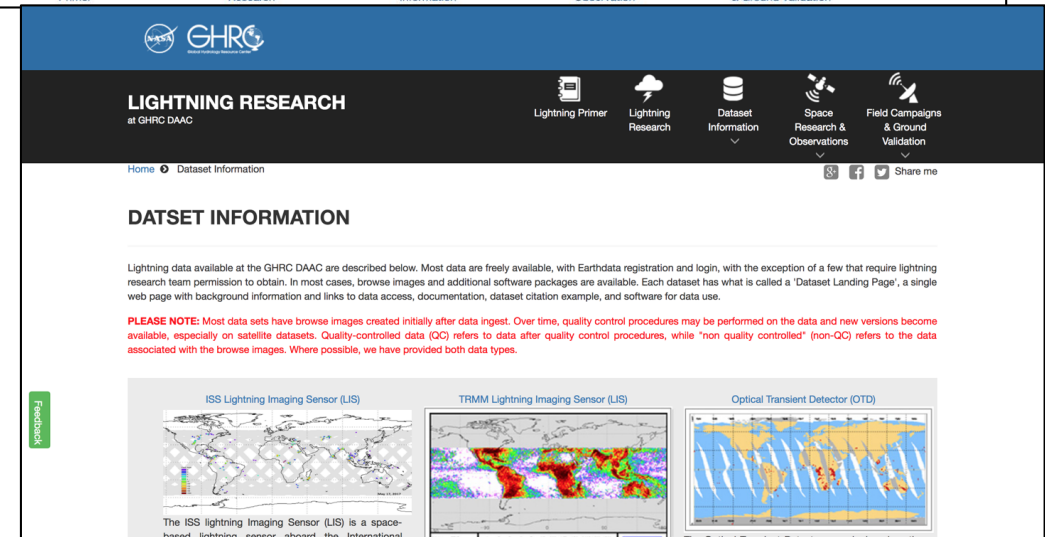
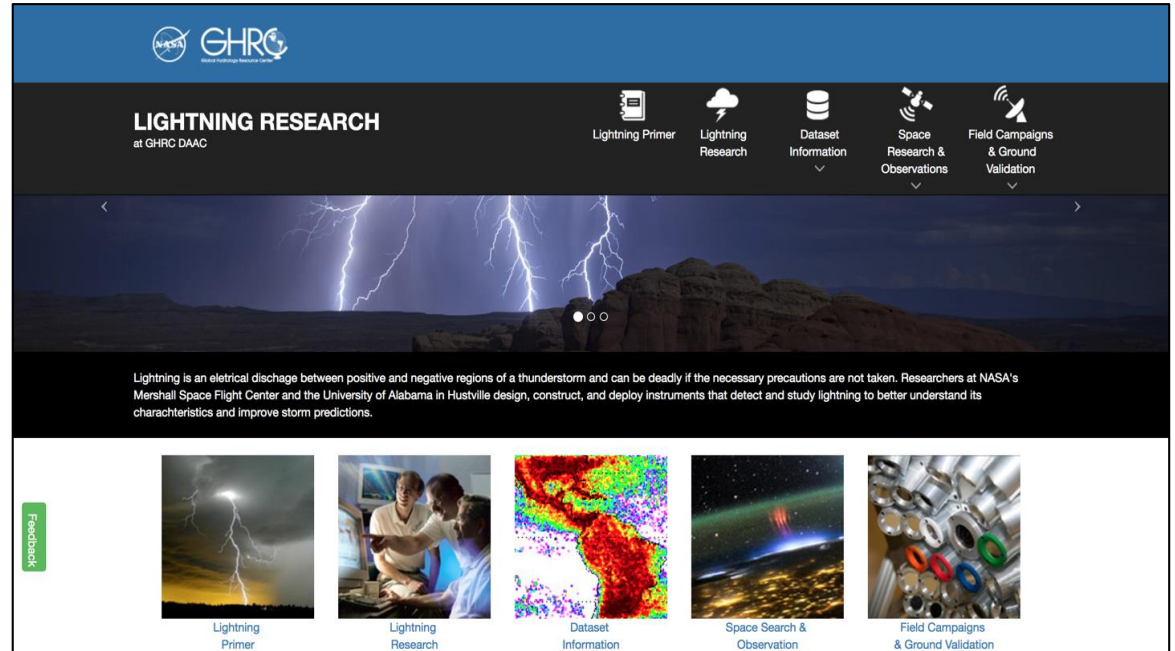
Lightning Support at GHRC

We took lightning data to the Summer ESIP Research as Art Session. This will also be presented at AGU 2017 Fall Meeting and the AMS 2018 Annual Meeting



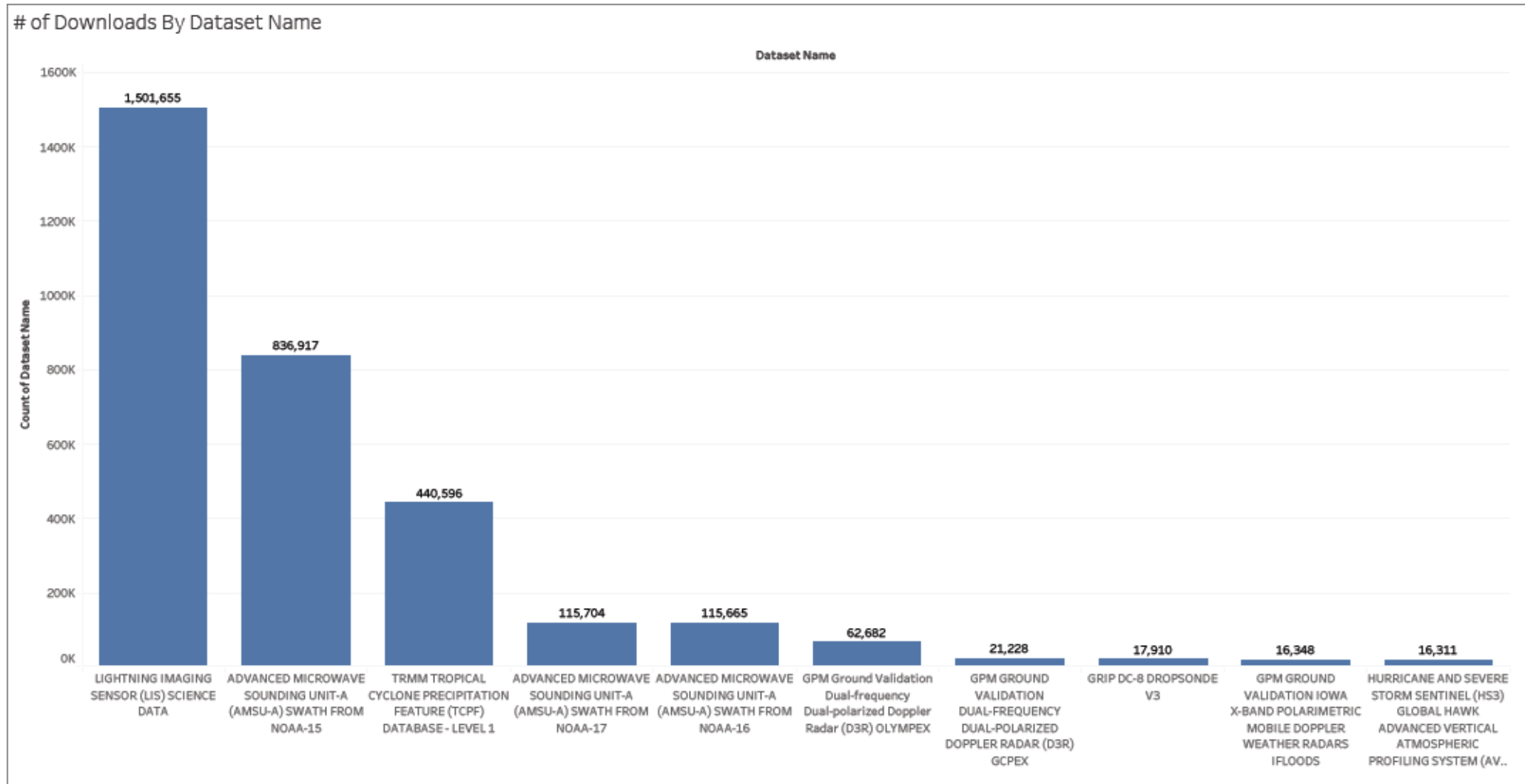
Redesigned Lightning Web Page in Progress

- New design that will be on Drupal 8 server
- Images and text updated
 - ISS and TRMM LIS datasets distinguished
 - GLM added linking to NOAA CLASS
 - Access to restricted data removed
 - Dated content removed
- Linkages improved between data, contents and GHRC web site
- Micro articles and Data Recipe links added
- Take a look at:
<https://lightningtest.nsstc.nasa.gov/>



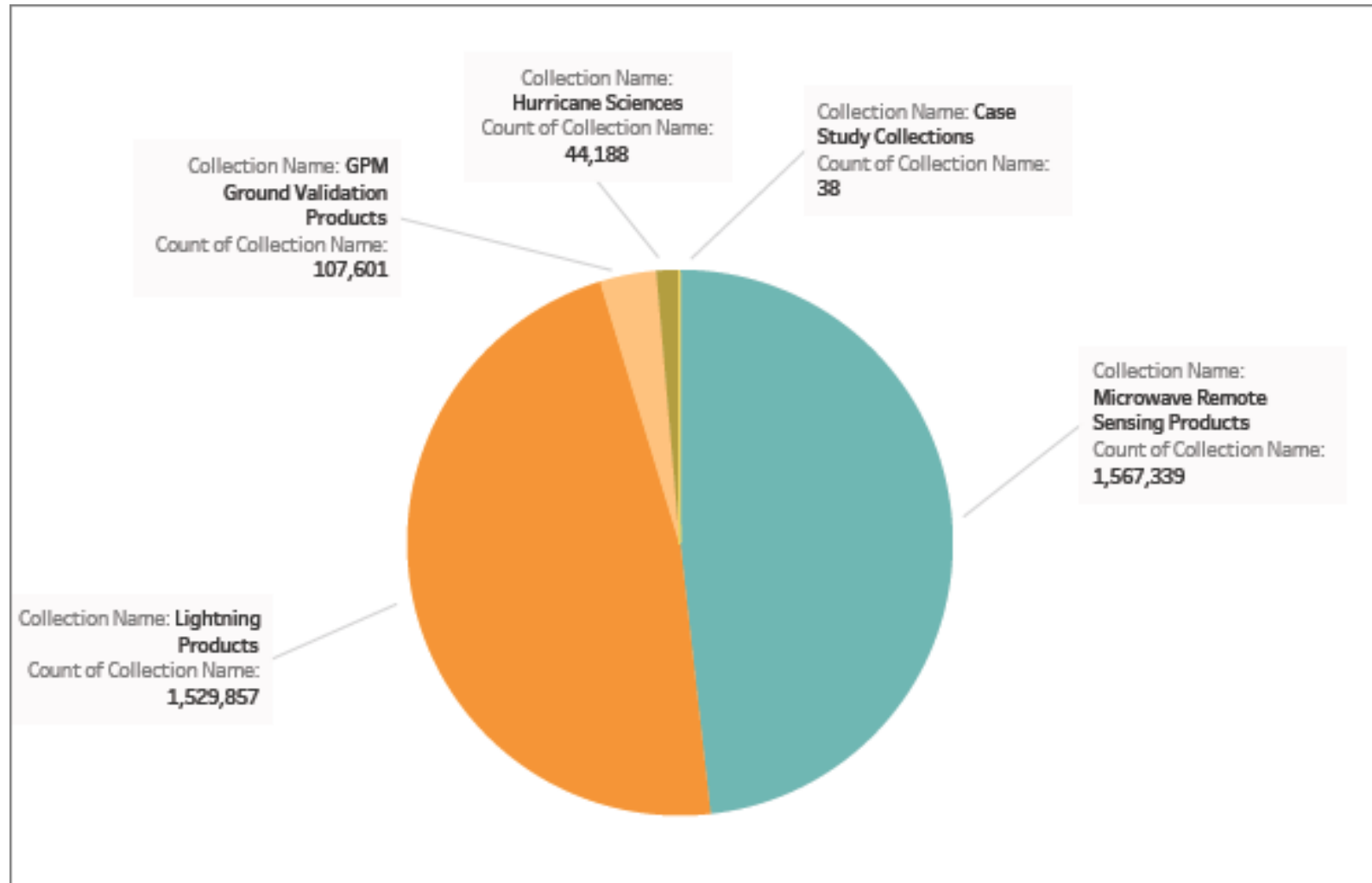
Lightning Data Download Metrics

Lightning datasets are most accessed data in 2017



Lightning Data Download Metrics

As a collection, lightning datasets have the 2nd highest number of data file downloads



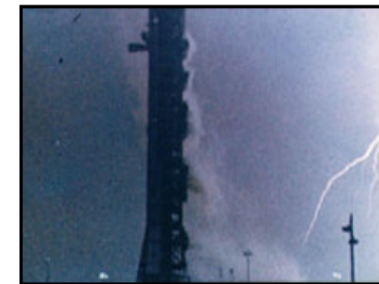
- Update visualization tools as resources allow
 - browse calendar
 - google earth plots
- Further improve Lightning Primer by working with lightning team scientists and UWG members
- Complete the Lightning Virtual Collection
- Produce more Micro Articles and Data Recipes
- Develop an easy-to-use lightning product for GIS use
- Create a curated publication list aimed at high school / undergrad level
- Explore other tool ideas

A Lightning Primer

Introduction

Lightning, the thunderbolt from mythology, has long been feared as an atmospheric flash of supernatural origins: the great weapon of the gods. The Greeks both marveled and feared lightning as it was Zeus. For the Vikings, lightning was produced by Thor as his hammer struck an anvil while riding across the clouds. In the East, early statues of Buddha show him carrying a thunderbolt with an end. Native American tribes in North America believed that lightning was due to the flashing feathers of a mystical bird whose flapping wings produced the sound of thunder.

Today, scientific rather than mystical techniques are used to explain lightning with experimental data replacing intuitive concepts. Yet, we remain in awe of lightning which still shines with its mystery. Typically, more than 2,000 thunderstorms are active throughout the world at a given moment, the order of 100 flashes per second. Each year, lightning is responsible for about 24,000 deaths, 240,000 injuries per year, and millions of dollars in property damage per year.



Lightning striking near a spacecraft (Photo credit: NASA)

While these are more than sufficient reasons for NASA lightning research, lightning has a direct effect on spacecraft operations as well. The avoidance of lightning strikes on spacecraft during launch relies heavily on the ability of meteorologists to accurately forecast and interpret lightning hazards to NASA vehicles under varying weather situations. Lightning have been well documented. One major incident was the Apollo 12 mission when lightning briefly knocked out the astronauts' radio, but they regained control.

The unmanned Atlas Centaur 67 carrying a Naval Air Station was struck by a triggered cloud-to-ground lightning strike, which apparently altered memory in the digital flight control of a hard-over yaw command, which caused an explosion and ultimately the breakup of the vehicle.

On a smaller scale, two sounding rockets being prepared for launch from NASA's Wallops Island were delayed as a direct result of lightning.

It is now well recognized that lightning strikes near aircraft most often originate from the craft itself. It is the inception of a leader, propagating in both directions away from the craft. These are called "triggered" lightning.



Discussion / Questions?

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